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Exploring Affordances Provided by Online Non-Curricular Resources to Undergraduate Students Learning Software Development

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Abstract: This study explored how students learning software development used online non-curricular resources during three months. It combined digital traces, self-reports, interviews and course documents to analyze how these resources provided learning affordances and support for pursuing learning purposes. Findings reveal complex arrangements of people and resources across different contexts, which translated into several interrelated affordances and purposes.

Introduction

Computer and software engineering (CSE) students' learning software development increasingly integrate online ecosystems related to the work of professional developers (e.g., GitHub or Stack Overflow) (Storey et al., 2017). Previous studies indicate students use resources from such ecosystems while learning programming, even when those resources are not integrated in the course curricula (Damşa & Nerland, 2016). Such studies suggest these resources are used for different purposes and that they play a key role in student learning by enabling the access to information, socialization and the understanding of knowledge (Dommet, 2019; Mills et al., 2014). Yet, learning and educational research has given little attention to how student learning happens and what processes are at play when students use such online non-curricular resources.

This study aims at shedding some light on this matter by exploring students' use of online resources that are related to the work of professional developers. It views the use of these resources as part of the enactment of learning practices. Practices are seen as enacted in context, in the form of discursive-material configurations that involve affordances and purposes (Mahon & Kemmis, 2017). That is, relations between abilities of people and the features they perceive in resources (Chemero, 2003), and the subjectivities that explain why these relations are formed (Garrick & Solomon, 1997). Thus, the enactment of practices is analyzed in relation to how resources are 1) used in context (higher education, personal life, work life), 2) how they function as learning affordances (e.g., to communicate, understand concepts, collaborate), and 3) which purposes they help serve (e.g., obtaining future rewards, advancing in tasks, belonging to groups). Different types of data are combined to answer these research questions: RQ1: What people and resources describe students' use of websites connected to professional development? RQ2: How do these relations translate into configurations of contexts, affordances and purposes?

Methods

This study is part of a larger research project that collects different types of data on students' use of online non-curricular resources for learning. Participants were 16 students from CSE programs at four large universities in Norway. Using a mixed-methods design, students were asked to answer a questionnaire about four categories of activities linked to professional developers' work, the websites used for these activities and other background questions. Once submitted, a custom-made software collected three months of digital traces of each website reported. These traces served as an input for stimulated recall interviews (Dempsey, 2010) that explored in-depth the enactment of practices during the three months. The analytical strategy involved two stages. To answer RQ1, qualitative content analysis of the interview data combined with questionnaire responses was applied to identify relations involving people and resources related to the four categories of activities. To answer RQ2, a qualitative analysis of affordances and purposes of the interview data was applied in combination with course documents.

Findings

The findings indicate large arrangements of websites, online resources and people connected to four practices enacted during the three-month period. In total, the enactment of these practices involved 34 different websites and relations with different people, such as teachers, students, friends and professional developers. Groups of people and resources, notably, were sometimes seen more as a single entity than as sums of components. These practices (see Table 1) often wise were enacted simultaneously, in a complementary way, and sometimes different practices were seen as inseparable. The second stage of the analysis revealed practices were enacted in several contexts, including course assignments, daily life situations and business projects, involving relations that

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translated into different types of learning affordances (see Table 2). These affordances differed greatly between project-based course assignments and theory driven ones, involving different people and types of online resources. Moreover, affordances were also sometimes interrelated with one another and established for different purposes. These purposes included contributing to student groups, family and friend projects, seeking future job opportunities, advancing in programming tasks, understanding concepts, personal interests and diversifying skills.

Table 1: Examples of websites, online resources and people observed in the enactment of practices

Practice	Examples of Websites (# of students)	Examples of Online Resources
1. Problem solving	W3Schools (14), Stack Overflow (15), Google (16), YouTube (16), FB Messenger (10)	Code components, source code, tutorials, text messages, solutions to problems
2. Staying up to date with trends	YouTube (11), Google (9), Stack Overflow (6), GitHub (6), Discord (4), Twitter (3)	Technology news, professional developers opinions
3. Deliberate learning	W3Schools (14), Stack Overflow (12), YouTube (16), Geeks for Geeks (7)	Code components, source code, explanations of concepts and methods
4. Future career management	LinkedIn (4), GitHub (3), Gmail (2), YouTube(2), Google (2)	Job offer descriptions, career guidance blogs

Table 2: Examples of affordances found in the interview data by category

Category	Examples of Affordances	Excerpts from Interview Data
Material Affordances	Communicating, sharing code, and searching for explanations of methods.	"[We] show pictures or prototypes of the app that we made, by screen sharing [on Zoom] (…)".
Mental Affordances	Examining code and looking at explanations of methods or concepts.	"[I] read what they say or try to interpret the code [on Stack Overflow] (…)".
Intersubjective Affordances	Giving and receiving feedback, planning activities, discussing code.	"[They] sit [on Discord] and tell you: 'this is wrong [in your code] because this and this'."
Translation Affordances	Reusing code components into own source code, repeat steps in tutorials.	"[I] copy/paste [code components from Stack Overflow], with tweaks to make it work".

Discussion and conclusion

Findings show learning practices were enacted in ways similar to the work of professional developers (Nerland, 2008). Furthermore, these practices' configurations varied across contexts and involved interrelated learning affordances and purposes that emerged out of complex relations established between different people and online resources. It comes to light from the findings that these relations were central for students' learning processes, and that their purposes cannot be just related to the accomplishment of curricular goals and academic performance. Students used websites and online resources with a future oriented approach that went even beyond graduation itself and that was influenced by people, groups and resources in complex ways. The current project intends to explore further the use of websites and online resources by examining how these configurations are formed.

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